APREL

Technical Specification
2013

Standard ALSAS 10 Universal SAR & HAC (software)

ALSAS-10U System

APREL ALSAS-10U is fully optimized for the dosimetric evaluation of a broad range of wireless devices. Developed in line with the latest methodologies it is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209 Part 1 & 2, CENELEC (EN50361), ARIB, ACA, and the Federal Communications Commission.

ALSAS-10U has been developed with a strong focus on application development with custom modular software/hardware for the broadest range of wireless testing, including dosimetry research and measurements utilizing various phantoms – Right and Left SAM Phantoms, UniPhantom™, Uni-Flat Phantom, and full size Flat Phantom. Free space E-Field measurements of mobile devices and base station antennas can also be executed using ALSAS. With the current ALSAS configuration, several phantoms and setups can be arranged around the system – and since the phantoms are designed to be light and easy to move for interchanging between test frequencies compliance test times are improved.

ALSAS-10U is designed to cover the frequency range from 30MHz to 6GHz as per the IEC 62209 Part 2 standard. There is no limiting factor to the operating RF carrier frequency range for the ALSAS-10U system other than the phantoms chosen for testing. The ALSAS-10U has been designed to be modular and phantoms are integrated onto the Universal Workstation ™ to allow for complete flexibility of the measurement process. This unique design allows for a fully flexible system which can be built around the exact needs of the user.

- ALSAS-10U can calculate multi-peak SAR and perform multi-cube analysis automatically.
- The scanning interpolation, and extrapolation methods conform to international standards.
- Probe tilt is included so as to meet IEEE 1528 and IEC 62209 Part 1 & 2 standards requirements.

Miniature E-Field Probe ALS-E-020S

The APREL E-Field probe utilizes an orthogonally triangular sensor arrangement.

E-Field Probes have been characterized from 30MHz to 6GHz with the probe diameter scientifically verified for use at frequencies above 3GHz eliminating the need for separate probe types.

The isotropic E-Field probe used by APREL, has been fully calibrated and assessed for isotropy and sensitivity in both air and tissue, including boundary effect within a controlled ISO-IEC 17025 accredited laboratory.

Test setup allows probe to be positioned at a user defined or default height(s) of 2.4 or 4 mm from phantom surface to minimize any resultant boundary effect due to the probe being in close proximity to the phantom surface which provides improved measurement uncertainty at higher frequencies.

A new 2.8 mm probe is now available for use at higher frequencies (5-6 GHz) allowing for smaller scan resolutions and greater measurement point density.

Compliant Standards	IEEE 1528, IEC 62209 Part 1 & 2
Frequency Range	30 MHz ~ 6 GHz
Sensitivity	Better than 0.8 μV/(V/m)^2
Dynamic Range SAR	0.001 W/kg to 100 W/kg
Isotropic Response Axial	Typically ± 0.1dB
Hemispherical isotropy	±0.3 dB or better
Linearity	±0.2 dB or better
Probe Tip Radius	User selectable all <5 mm
Sensor Offset	1.56 (± 0.02 mm)
Probe Length	290 mm
Video Bandwidth	@ 500 Hz: 1 dB @ 1K Hz: 3 dB
Boundary Effect	Less than 2% for distances greater than 2.4 mm
Material	Ertalyte™
Connector	6 Pin Bayonet

Custom Probes are available on request

Universal Device Positioner ALS-H-E-SET-2
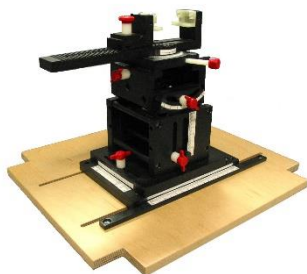
The APREL Universal Device Positioner has been developed to hold a device under test in touch, tilt or arbitrary positions with complete freedom of movement of a DUT under a phantom. The design allows avoiding additional loading attributable to the material of the positioner and reducing measurement uncertainty.

Positioner has a built-in 15 degree feature used for fast and accurate touch to tilt movement.

The APREL device positioner can hold in-place devices such as handsets, smart phones, clam shell phones, PDA's, small size tablet PC's, etc.

The device positioner can be used for SAR and HAC testing (Hearing Aid Compatibility).

When used with the Universal Work Station and its adjustable shelves, the positioner provides all 6 degrees of motion, making positioning of the DUT against a phantom easily adjustable.

Optional additional clamping mechanisms are available to pre-mount the test device (useful for QA testing)

Compliant Standards	IEEE 1528, IEC 62209 Part 1 & 2
Dielectric constant	Less than 5.0
Loss Tangent	Less than 0.05
Number of Axis	6 axis freedom of movement
Translation Along MB Line	± 76.2 mm
Translation Along NF Line	± 38.1 mm
Translation Along Z Axis	± 25.4 mm (expandable up to 500 mm)
Rotation Around MB Line (yaw)	±10°
Rotation Around NF (pitch)	± 30°
Line Rotation (roll)	360° full circle
Maximum Grip Range	0 mm to 150 mm
Material	Resistant to DGBE and all other tissue stimulant materials as listed in IEEE 1528 Annex C.1.
Tilt Movement	Full movement with built-in 15° gauge
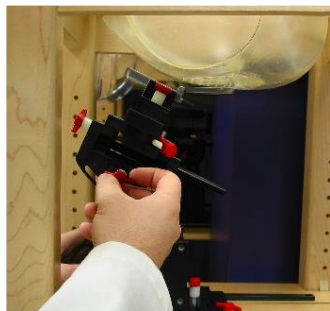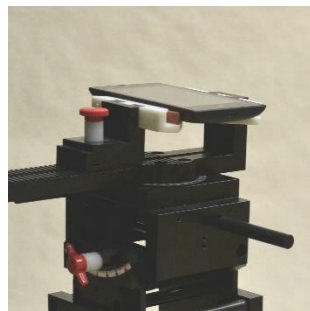
6 Axis Articulated Robot ALS-F3

ALSAS-10U utilizes a six axis articulated robot, which allows full freedom of movement for each of the six joints within the working envelope.

The accuracy of the probe tip positioning over the measurement area is better than 0.05 mm.

The robot is capable of moving the probe to angles greater than 30°.

APREL software, probe mounting module and surface detection system provide precise probe positioning and tilt normalized to the SAM phantom surface during SAR testing. Test results repeatability for averaged 1 g and 10 g SAR is within ±2% depending on frequency and device under test.

Built-in emergency stop system provides safe work space environment.

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Power Voltage Range	Single-phase, 230 VAC-10% to 240 VAC + 10% Three-phase, 200 VAC -15% to 230 VAC + 10%
Power Supply	50/60 Hz
Number of Axis	6
Positioning Resolution	0.05 mm
Teaching System	Remote teaching Numerical entry
Robot Reach	770 mm
Repeatability	In each X, Y and Z ±0.03 mm
Probe protection	Built in "emergency stop"
Communication	RS232, EtherNet (GbE), USB, VGA (optional)
Environmental condition	Temperature: 0 to 40^{0}C Humidity: 90% RH or less (no condensation allowed)
Safety Category	Standard Specification Category 4, PL = e (ISO 13849-1)

APREL Left and Right SAM Phantoms
ALS-P-SAM-L / ALS-P-SAM-R

The APREL SAM phantoms have been designed so as to aid repeatability and positioning for any DUT. Developed using the IEEE SAM CAD file they are fully compliant with the requirements for IEEE 1528, IEC 62209 Part 1 and 2 and FCC Supplement C. The phantoms are transparent and include the IEEE 1528 grid with visible NF and MB lines, the device positioning repeatability provides reduced uncertainty. The SAM phantoms Corian® frame provides additional support and load bearing characteristics.

APREL SAM phantoms are sustainable to the Head and Body tissue simulating liquids.

Compliant Standards	IEEE-1528, IEC 62209 Part 1 & 2
SAM	In accordance with the IEEE 1528 standard
Material	Composite urethane, resistant to DGBE
Phantom Shell Shape Tolerance	Fully calibrated to be better than ± 0.2 mm
Frame Material	Corian®
Tissue Simulation Volume	7 liter with 15.0 ± 0.5 cm tissue
Thickness	2 mm ± 0.2 mm 6 mm ± 0.2 mm at NF/MB intersection
Loss Tangent	<0.05
Relative Permittivity	<5
Resistant to Solvents	Resistant to all solvents used for tissue manufacturing detailed in IEEE 1528
Load Deflection	<0.2 mm with sugar water compositions
Manufacturing Process	Injection Molded
Phantom Weight	Less than 10kg when filled with 15cm of simulation tissue
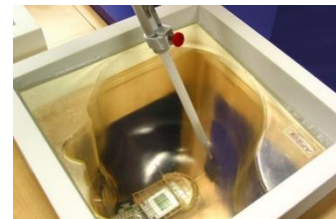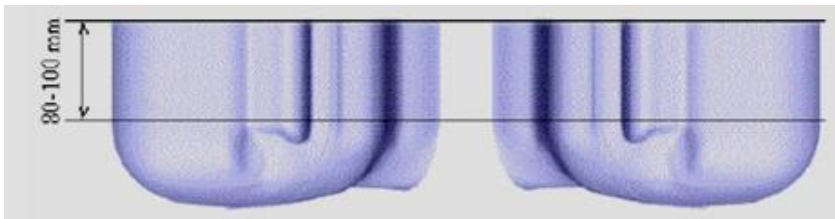
APREL Flat Phantom ALS-UM-FLAT

The APREL Flat Phantom has been developed as an engineering tool for SAR compliance and development testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. The enhanced design allows repeatable measurements for a wide range of devices, including handsets, PDA units, laptops, tablets, computers, and validation dipoles.

The APREL Flat Phantom is IEEE 1528; IEC 62209-1/IEC 62209-2 (Elliptic flat phantoms); FCC OET Bulletin 65 /Ed. 97-01 (custom flat phantoms) compliant and compatible with tissue-equivalent liquid chemicals.

Compliant Standards	IEEE-1528, IEC 62209, CENELEC, and others
Manufacturing Process	Compression molded
Material	S-Glass and Vinyl Ester Resin
Phantom Shell Shape Tolerance	Less than $\pm$ 0.2 mm
Operating Frequency Range	30 MHz – 6 GHz
Tissue Simulation Liquid Volume	12.8 liter with a liquid depth of 150 mm
Shell Thickness	2mm $\pm$ 0.2mm
Loss Tangent	< 0.05
Relative Permittivity	< 4
Resistant to Solvents	Resistant to all solvents specified in IEEE 1528, IEC 62209 (Part 1 and 2)
Load Deflection	<1.8 mm
Dimensions without frame	320 mm x 250 mm x 225 mm

# ALS-Uni-Large (30MHz-6GHz) Supports IEC 62209 Part 2

When testing below 100MHz the Large Flat Phantom should be used in line with IEC 62209 Part 2 requirements.

Also Uni-Large Flat Phantom could be used for SAR dosimetric evaluation of base station antennas and larger transmitting devices.

Solvent resistant body with clearly visible, marked reference grid for easy and repeatable device positioning. Supplied with 800mm ergonomic support.

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Compliant Standards	IEEE-1528, IEC 62209, CENELEC, and other global standards
Frequency Range	300 MHz – 6 GHz
Phantom Shell Shape Tolerance	Less than $\pm$ 0.2 mm
Operating Frequency Range	30 MHz – 6 GHz
Shell Thickness	6 mm $\pm$ 0.2mm
Loss Tangent	< 0.05
Relative Permittivity	< 4
Resistant to Solvents	Resistant to all solvents specified in IEEE 1528, IEC 62209 (Part 1 and 2)
Load Deflection	<1.8 mm
Dimensions without frame	800 mm x 500 mm x 200 mm
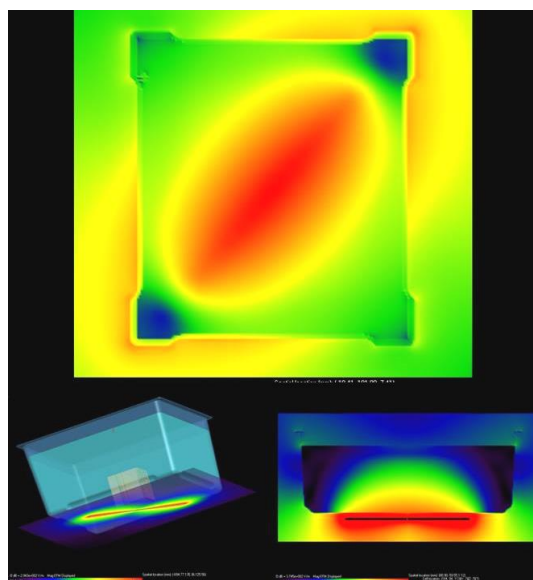
Additional Phantom Specification Details

The full range of APREL phantoms designed for SAR assessment and compliance testing are made of low loss and low permittivity material.

To enable device under test to be reproducibly positioned every phantom has reference grid/marks.

- Weight of SAM and Universal Phantom ™ when filled is less than 10 kg.
- Lower volume phantoms need about 7 liters of tissue for SAR measurements.
- Phantom shell thickness tolerance is less than ±0.2mm
- Shell thickness of every phantom is individually tested.
- Clear SAM Phantoms for improved positioning of DUT and measurement repeatability provides overall improvement to uncertainty of the SAR measurement.
- APREL phantoms are easy to maintain and store utilizing Phantom Storage Unit.
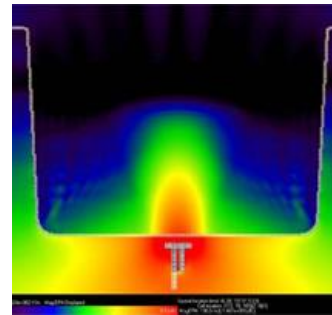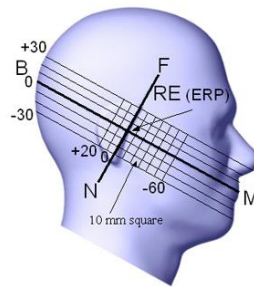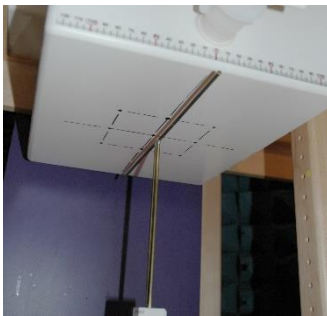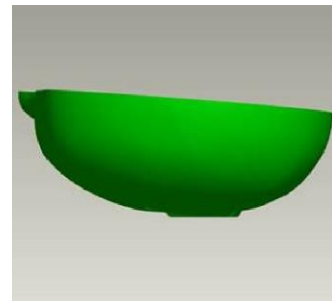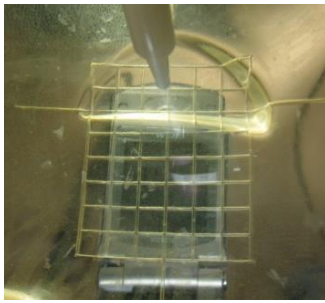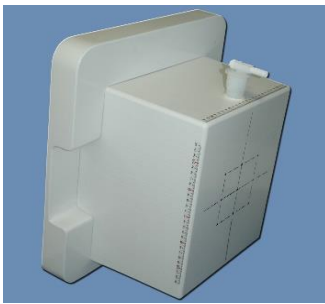
DAQ-PAQ (Analog to Digital Electronics) ALS-DAQ-PAQ-3 Boundary Detection Unit ALS-PMDPS-3

DAQ-PAQ

PMDPS

Probe
Mounting
Device
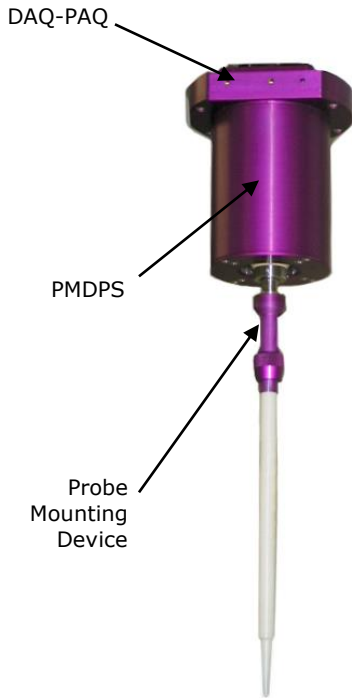
ALSAS 10U incorporates a fully calibrated DAQ-PAQ (analog to digital conversion system) which has a 4 channel input stage, combined with the integrated amplifier module. The input signal is amplified accordingly so as to offer a dynamic range from 4 µV to 330 mV. Integration of the fields measured is carried out at board level utilizing a Co-Processor utilizing proprietary algorithms. Improvements to measurement speed are improved by sending processed data down to the main computational module.

PMDPS is a probe holding unit with complex curved and flat surface detection module for SAR or HAC testing. It utilizes relative movements of internal components to trigger integrated micro-sensor mechanisms in order to detect boundary(s) and consequently position the probe at the specified distance and normalized tilt relative to a boundary in order to achieve accurate and repeatable measurements.

PMDPS e-stop feature will shut down the ALSAS-10U system if there is any malfunction of the arm (due to power outages), erratic motions (due to operator error), or hard collision (phantom, DUT, or any solid surface). The ALSAS-10U PMDPS controls the distance between phantom and center of the probe sensors and allows for improved positioning accuracy of the robot arm.

All surface detection methods are controlled by a proprietary algorithm which dynamically compensates for every detection point, and allows for a 20-30% improvement to surface detection speeds. By eliminating optical detection sensors uncertainty is further reduced by integrating micro detection sensors which can determine movements of less than 1µm.

Amplifier Range	4 μV to 330 mV
ADC	16 Bit optically isolated
Built-in E-Stop Feature	Emergency Stop feature to prevent damage of equipment and for user safety purposes
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
SAR Dynamic Range	0.001 W/kg -100 W/kg.
Ambient Noise	Below 0.001 W/kg measured with probe in tissue
LED Indication	Boundary detection and DAQ-PAQ State
Number of Input Channels	4 in total 3 dedicated and 1 spare for future upgrades (when and if needed)
Communication	Optically isolated packet data via RS232
Robot Arm Integration	DAQ-PAQ and Boundary Detection Unit are mounted directly onto joint 6 of the robot arm utilizing joint 6 tool (ISO Standard M8 Mounting Plate) to allow easy integration and removal (no angular interface)
Supply	DC supply powered by an isolated external supply unit (no battery required)
LED Indicators	Probe status (amplifier on) and boundary detection

Additional PMDPS Specification Details

Accuracy of Positioning: Better than 10μm at 6GHz.
SAR Uncertainty: Better than 0.01 W/kg SAR at 6Gz.
Detection Mechanism: 2 x 360° Stage Axial and Lateral Detection at 6GHz.
Emergency Stop: 4 Stage 360° Axial and Lateral Detection at 6GHz.
Probe Mounting: 6 Pin Bayonet for Fast Probe Change.
Calibration: Every PMDPS is Calibrated to 0.01 W/kg SAR at 6GHz.
Reliability Expectations: Better Than 10,000,000 Cycles.

NOTE:

Measurement uncertainty attributable to probe positioning utilizing the PMDPS is greater with an increase to the RF carrier frequency. Uncertainty values documented above are the worst case. Consequently, for RF carrier frequencies below 6GHz, all uncertainties will be lower than those given above.

ALSAS Universal Workstation ALS-UWS

ALSAS workstation was developed with a strong engineering focus taking into consideration customer and client needs, and the necessity to have an integrated system which will allow for flexibility and fast adaptability ergonomically designed for ease of use.

The Workstation form is stable, robust in structure, and flexible, so that users can do calibration, test and measurements utilizing different types of phantoms with one set up, which significantly speeds up the measurement and assessment process.

Phantoms can be configuration includes 2 SAM (left and right) with a Uni-Phantom or the Flat phantoms which are available to support international standard (IEC 62209 Part 1 & 2). Additionally the centre portion of the workstation can be removed for HAC, and other user defined measurements.

The workstation system has a modular structure which can be easily adapted to specific customer requirements and needs. The maple stand can be removed from the main robot stand to incorporate other phantoms and setup scenarios. Phantoms are self contained modular units easily removable and swappable, and require the least amount of tissue compared to other types available.
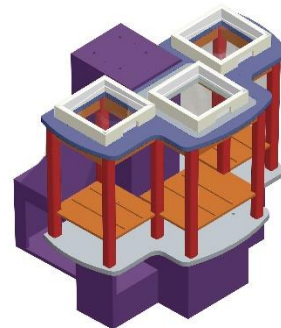
The workstation has been constructed entirely out of composite wood clad in Arborite™ and Canadian maple, with all metallic fasteners kept at a compliant distance from the device under test.

Workstation
without wooden part (rendering)
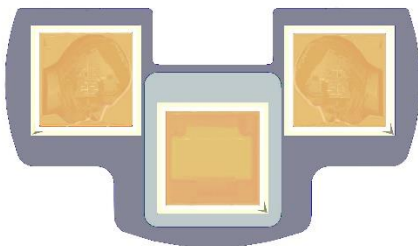
Workstation
Top view (rendering)

Workstation
without robot (rendering)

ALSAS-10U Test Software

Test Software	ALSAS
Field Measurements	Specific Absorption Rate evaluation with averaged 1g and 10 g SAR
	Support of E- H-field, HAC measurements including T-Coil, temperature probes;
	Single and continuous measurement modes;
	Output in µV, V/m, A/m, mW/g;
	Multiple measurement profiles (measurement time, sample time); including graded mesh for high density zoom scans
	Data logging to ASCII-files;
Field Scans	Measurement in lines, planes, curved surfaces (tilt), volumes in free space or restricted volumes (phantoms);
	Cube measurements with surface extrapolation and spatial SAR evaluation for 1g, 10g and/or arbitrary mass;
	Time measurements (source power drift);
	Probe rotation measurements (isotropy);
	Export of field scans to ASCII;
Visualization	3D isoline distribution;
	Device and phantom visualization in 2D graphics with measurement data overlaid;
	Freely configurable output graphic formats with automatic title and legend generation;
	New Numerical Feature with Remcom Inc XFDTD Enabling direct comparison of experimental and numerical results (Fall 2006);
Compliance Testing	Probe alignment normal to surface during entire scan (includes tilt);
	Automatic detection of all maxima;
	Around 10 min test time (or better) per device position;
	No user interaction needed during measurement (coarse scan, evaluation of cube maxima search, fine cube measurements and device power drift assessment);
	C63.19 HAC testing for E-H-Field and T-Coil.
System Validation	Predefined system validation procedure (compliant with IEEE/CENELEC/IEC guidelines);
	Additional checks, such as surface detection, probe isotropy, etc.
Report Generation	Reports generated in MS-Word, and txt formats for easy importation into compliance/design reports. Reports can include Jpeg images for the device (imported via main software) with contour plots overlaid and information can be adjusted in real-time.
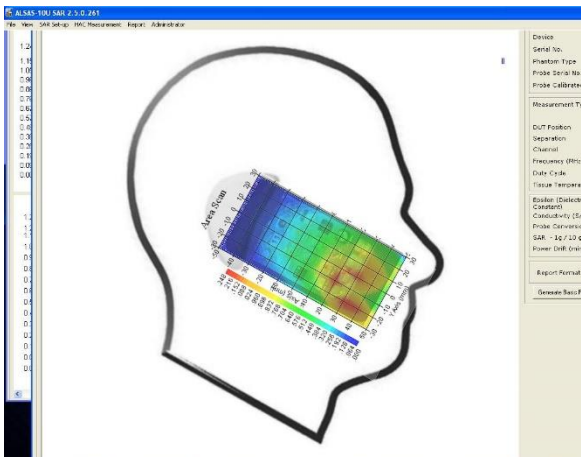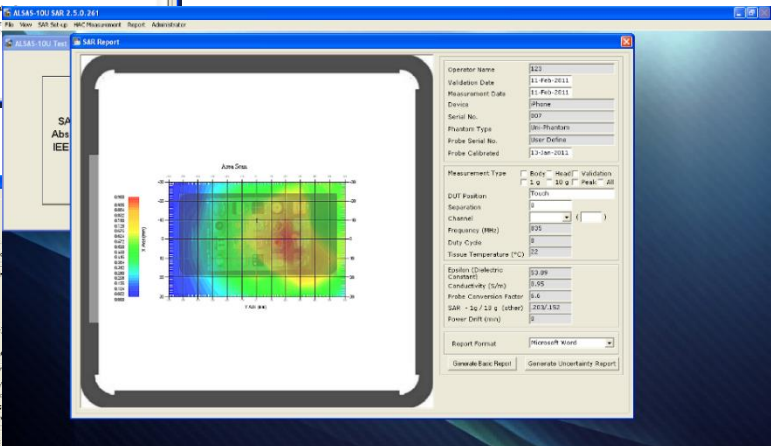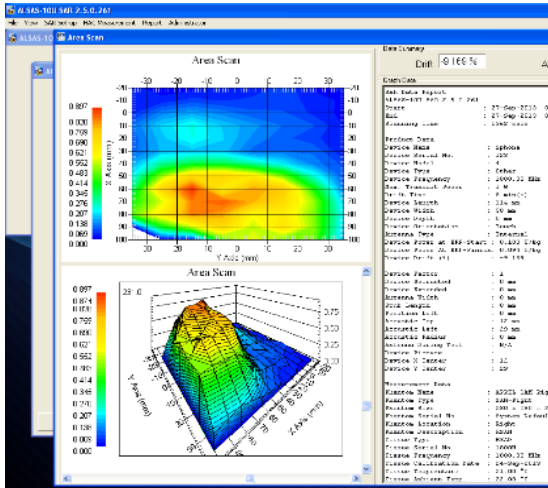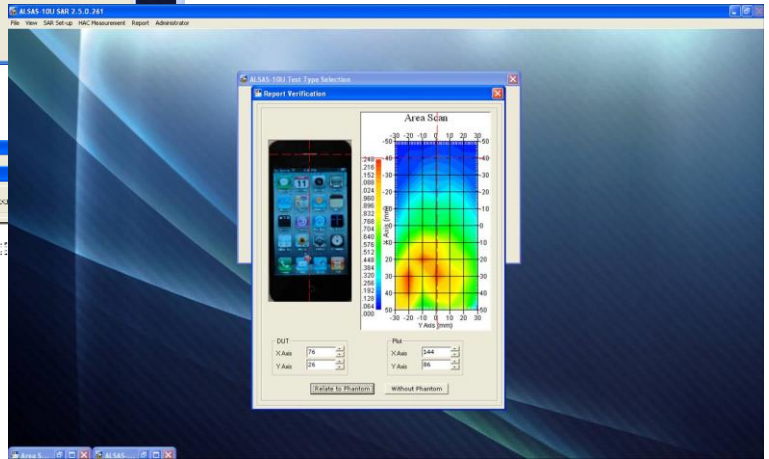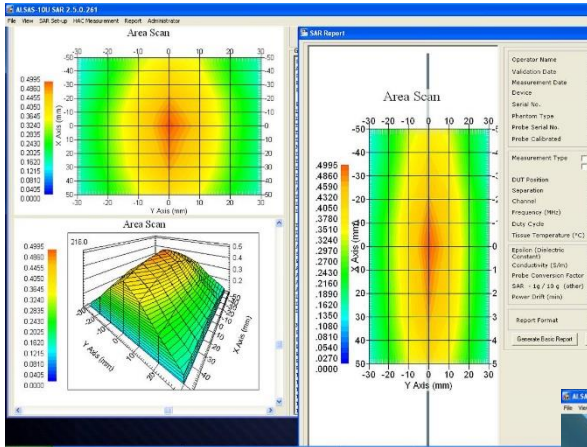
ALSAS-10U
Hearing Aid Compatibility Upgrade Suite for FCC HAC Compliance (ANSI/IEEE C63.19) and Development

APREL is a pioneer in the area of Hearing Aid Compatibility, and the ALSAS-10U HAC Upgrade Suite™ brings all of APREL's three decades of experience in HAC into one package. APREL is active in the development of industry-accepted methodologies for HAC measurement and have used this experience in the development of ALSAS-10U HAC Upgrade Suite™.

ALSAS-10U HAC Upgrade Suite™ is ideal as a primary compliance instrument for Hearing Aid Compatibility or as a design/development tool for HAC Audio and near-field E- and H-Field emission evaluation of wireless handsets and hearing aids. The suite is designed for developers, compliance experts, regulators, and researchers.

A fully flexible measurement system that is a true compliance and wireless/antenna designer's tool, ALSAS-10U HAC Upgrade Suite™ is designed to be all you need for Hearing Aid Compatibility testing.

ALSAS-10U HAC Upgrade Suite™ is an affordable and easy to use application for first time and experienced users alike, and for small, medium or large laboratories and manufacturers who need access to complex HAC evaluations of wireless products (handsets, smartphones, cordless, and others). It is an expandable system which can measure devices operating up to 6 GHz and will grow with technological and standards developments.

This product is ideally suitable for use in a fast paced development area where assessments are needed for research & development, compliance and pre compliance. It is easy to deploy, learn and use.

Basic system configuration

✓ Software platform (ALSAS-10U HAC Upgrade Suite™ V1.0.0.), based on industry-recognized test methodologies and FCC-mandated test standards (ANSI/IEEE C63.19 2007) used for HAC RF certification
✓ Software includes features for advanced audio band testing, signal generation and FFT analysis
✓ Automated X,Y,Z precision probe movement system
✓ Full graphic package for visualization and manipulation of measured fields
✓ 3D E-Field HAC probe with two standard frequency calibrations
✓ 3D H-Field HAC probe with two standard frequency calibrations
✓ Two standard frequency validation dipoles
✓ Active Twin-Axis T-Coil probe calibrated up to 10 kHz
✓ Audio Daq-Paq with built in amplifier for T-Coil calibration (requires an additional Helmholtz Coil and software upgrade)
✓ Catalyst-5 laboratory-grade robot with 5 degrees of freedom
✓ Optional training and support packages available

Description	Performs HAC testing for wireless communications devices (Wireless Device WD) using software developed for FCC compliance testing (ANSI/IEEE C63.19 2007 methodologies).
Software	User friendly GUI that allows for easy setup and data retrieval Includes signal generator (no additional equipment needed) Full FFT (Fast Furrier Transform) analysis Multiple Octave Settings (user defined or standard) Tone generation (comes with ITU P50)
Applications	RF Emissions Test - Measurements of the near-field electric field and magnetic fields emitted by a WD RF E-Field emissions V/m RF H-Field emissions A/m AF T-Coil tests ABM1 intensity and frequency response ABM2 Fast furrier transform analysis and audio quality
Typical Test Bands	SMR 800, SMR 900, Cellular 850, PCS 1900 Custom bands available on request (VOIP) 700 MHz band available soon
Report Generation	MS Word report generated according to FCC requirements
E-Field Probe	3-D E-Field Probe used for RF emissions testing of a wireless device Typical sensitivity: 1.0 mV / (V/m) Typical isotropy: 0.2 dB
H-Field Probe	3-D H-Field probe used for RF emissions testing of a wireless device Typical sensitivity @ 835 MHz: 200 mv / (A/m) Typical sensitivity @ 1880 MHz: 440 mv / (A/m) Typical isotropy: 0.3 dB
Active Twin-Axis T-Coil Probe	Converts magnetic fields of audio frequencies into AC voltage. Built in preamplifier module which allows for extended dynamic range Designed to sense axial and radial fields Typical frequency range: 100 Hz to 20 kHz Typical sensitivity: -60 dB(A/m) to 20 dB(A/m)
Validation Dipoles	Typical performance is better than -10dB RL for SMR 800 (iDEN) SMR 900 (iDEN) Cellular 850 (GSM, CDMA, WCDMA, TDMA) PCS 1900 (GSM, CDMA2000, WCDMW, CDMA1x, TDMA) Custom dipoles available on request (VOIP) 700 MHz available soon
Magnetic Dipole	Used to calibrate and validate automated methods used for HAC audio band magnetic system testing (ALSAS-10U HAC Upgrade Suite™) Serves as a known source for audio band magnetic fields for system validation and calibration
TMFS™ (Telephone Magnetic Field Simulator)	Can be used as a Telephone Magnetic Field Simulator (TMFS™) for hearing aid design.
Audio DAQ-PAQ and Integrated Power Amplifier	All-in-one box ADC (DAQ-PAQ) 16 Bit Amplifier Range up to 100 dB input Output @ 50 Ω relative to 1 Khz -4 dBV Communications via USB
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
LED Indication	Emergency stop and DAQ-PAQ state

| Number of Input Channels	4 in total: 3 dedicated and 1 spare for future upgrades
Communication	Packet data via RS232 and USB
Ambient Noise	20 dB below intended measurement limit
Supply	Robot and controller supplied by 110 or 220 V standard (country specific) supply Communications and control expander supplied by dedicated DC source (no battery required)

Optional HAC products available for order

- E-Field and H-Field probes (basic system comes with one of each)
- Passive T-Coil probe
- Helmholtz Coil for calibration of T-Coil probe
- T-Coil probe calibration software
- Additional Validation Dipoles
- Custom calibrations
- Custom test protocols
- Training (Seminars, or individual/company training)

Advanced Software Options for Audio Design
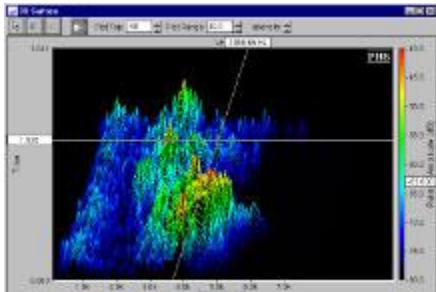
- Real-time FFT analysis of live input
- Record, Playback and Post Process WAV files
- Displays: Time Series, Spectrum, Spectrogram, 3-D Surface, Phase
- Full Featured Dual Channel Signal Generator
- High Resolution FFT Analysis up to 1,048,576 pts
- Octave Analysis from 1/1 to 1/96
- 24 bit precision, sampling rates to 200kHz and above (sound card dependent)
- Digital Filtering, Distortion Analysis, Transfer Functions
- Acoustic Tools: RT60, Leq, Delay Finder
- Automation Tools: Macro, DDE, Data Logging
- Amplitude Calibration: V, mV, dBV, dBmV, dBu, SPL or PA (in air or water), psi, or custom units
- Vibration Measurements: Acceleration (G), Velocity (ft/sec, in/sec, mils/sec, mm/sec), Displacement (ft, in, mils, mm)
- Independent Calibration and Scaling: each channel can be scaled and calibrated independently
- Signal Generator: Pink Noise, White Noise, Tone Burst, Noise Burst, 1 kHz Tone, Multiple Tones, Frequency Sweep, Level Sweep, IMD test tones, Pulse, Sawtooth, Triangular, Squarewave, User Defined (from .WAV source). DTMF, Digital Zero
- Utility Measurements: Peak Frequency, Peak Amplitude, Total Power
- Distortion Measurements: THD, THD+N, SNR, IMD
- Acoustic Tools: Reverberation Time (RT-60), Delay Finder, Stereo Phase Scope, Equivalent Noise Level (Leq, LeqT, Lsel, Lpk, Lmax, Lmin, L10, L50, L90

APREL Validation Dipoles ALS-D-Fx-S-2

- APREL have developed a range of dipoles for use in dosimetric SAR and HAC near field applications.
- Validation dipoles have been designed using the data presented in IEEE-1528, IEC-62209 1&2.
- Dipoles can also be manufactured and tuned to the users own specifications.
- All tuned dipoles have a return loss greater than -20 dBm, for dosimetric applications.

Features

- Tuned to specified frequency
- Dimensions harmonized with global standards
- Compatible with all commercially available SAR measurement systems
- Compatible with APREL Phantom stand
- Compatible with APREL Universal Device Positioner
- Conforming to SSI/DRB Standards

Applications

- Product Development
- SAR Near-Field Studies
- Compliance Testing
- Quality Assurance
- System Validation
- Probe Calibration

Compliant Standards	IEEE 1528, IEC 62209 Part 1 & 2, EN50361
Electrical	Symmetrical Dipole with variable λ/divisor
Frequency range	150 MHz – 6 GHz (User Specified)
Application	Tuned for Dosimetric System Validation
Material	Rigid Coated Brass
Dipole Diameter	3.6 mm
Calibration	Return Loss, Standing Wave Ratio, Impedance
Length	Dependent on frequency
Return Loss	> -20 dBm
Max Power Input	100 Watt

APREL, founded in 1981, is the wireless industry resource for,

- ✓ Specific Absorption Rate (SAR), MPE and RF Safety
- ✓ Acoustics and Hearing Aid Compatibility (HAC)
- ✓ RF and wireless, antennas and shielding
- ✓ EMC measurement systems

APREL provides expert services, consulting, training, standards development, compliance/certification, custom systems and research programs, as well as SAR and HAC instrumentation systems to the wireless telecommunications industry and government.

APREL employees hold senior and executive positions in multiple international standards organizations, including IEEE and IEC and work closely with international and national regulators.